Sustained Low Altitude Lunar Orbital Missions (SLALOM), Phase I

Completed Technology Project (2018 - 2019)

Project Introduction

The GRAIL and LADEE missions demonstrated the inherent value of skimming low over the lunar surface, yet they only probed below 10 km very briefly during periapse passages. Advanced Space proposes developing the means for flying spacecraft in an orbit that remains below 10 km altitude for weeks or months, opening the door to breakthrough scientific investigations. The proposed work will study an innovative system that may be used to achieve Sustained Low-Altitude Lunar Orbital Missions (SLALOM), enabled through autonomous onboard GNC capabilities and the use of Flash LIDAR.

The proposed study explores the dynamics of SLALOM, performs navigation analyses, evaluates maneuver planning methodologies, and researches how unique innovations in spacecraft autonomy can transfer operations from the ground to the spacecraft. Skimming the lunar surface autonomously with a spacecraft that remains below an altitude of 10 km is a challenging proposition that requires an entirely new approach to spacecraft navigation, maneuver design and execution, and spacecraft autonomy. SLALOM, with the requisite breakthrough improvements in guidance, navigation, and control technology, allows new scientific investigations such as the direct sensing and/or capture of lunar particles naturally lofted by the complicated dynamics of the lunar exosphere.

The benefits of the proposed innovation in spacecraft autonomy extend naturally to other airless bodies where sustained low-altitude orbits are mission enabling. These include, among others, the scientific and commercial exploration of asteroids and the Martian satellites Phobos and Deimos. While these applications are compelling, Advanced Space identifies the Moon as an ideal proving ground for this technology for many reasons, not least of which is to take advantage of the wealth of geodetic reference data generated by previous missions and the desire for low-altitude, high value scientific investigations identified by the lunar science community.

Anticipated Benefits

SLALOM makes possible the direct sensing or sampling of lunar regolith that has been lofted from the surface via interaction with solar UV radiation. In this way, a large number of sites of interest may be directly sampled using the same spacecraft: a capability far exceeding the reach of a rover or lander. Further, such low-altitude orbits allow remote-sensing measurements of unparalleled resolution, both at the Moon and other airless bodies such as asteroids and other natural satellites.

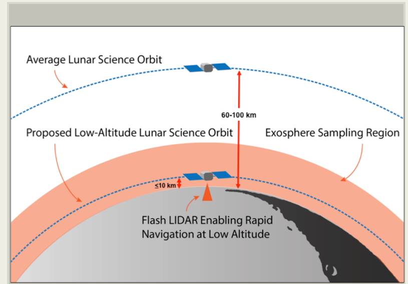

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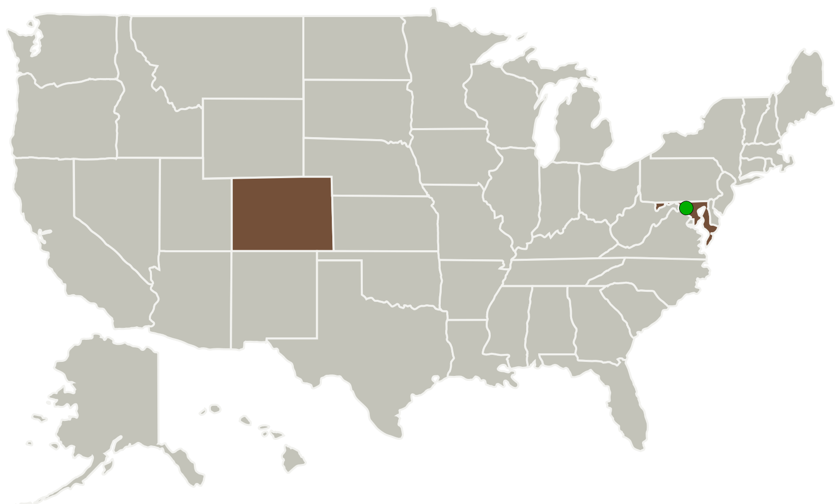
Table of Contents

Commercial interest in the exploration of airless bodies has grown significantly in the past decade, particularly as a means of identifying and extracting valuable space resources. The ability to operate autonomously at very low altitudes is enabling not only in the accuracy of measurements that can be collected, but also in the ability to operate a fleet of exploration space vehicles economically with a streamlined ground support footprint with minimal human interaction required.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Advanced Space, LLC	Lead Organization	Industry	Boulder, Colorado
Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations	
Colorado	Maryland

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Advanced Space, LLC

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

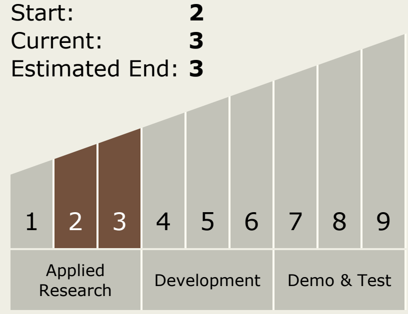
Carlos Torrez

Principal Investigator:

Jonathon Smith

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



Project Transitions

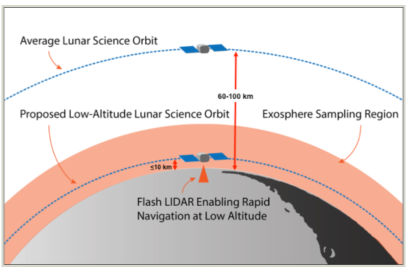
July 2018: Project Start

February 2019: Closed out

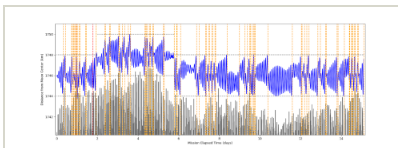
Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/137311)*

Images



Briefing Chart Image
Sustained Low Altitude Lunar Orbital Missions (SLALOM), Phase I
(https://techport.nasa.gov/image/132363)



Final Summary Chart Image
Sustained Low Altitude Lunar Orbital Missions (SLALOM), Phase I
(https://techport.nasa.gov/image/136019)

Technology Areas

Primary:

- TX05 Communications, Navigation, and Orbital Debris Tracking and Characterization Systems
  - └ TX05.1 Optical Communications
    - └ TX05.1.6 Optimetrics

Target Destinations

The Moon, Others Inside the Solar System